Chapter 6
Glossary of Terms

Absorbed Dose: The energy imparted to matter by ionizing radiation per unit mass of irradiated material (for example, biological tissue). The units of absorbed dose are the rad and the Gray. (See rad and Gray.)

Accelerator: A device that accelerates charged particles (such as electrons, protons, and atomic nuclei) to high velocities, thus giving them high kinetic energies. (Kinetic energy is the energy associated with motion.)

Accident: An unplanned event or sequence of events that results in undesirable consequences.

Accident sequence: An initiating event followed by system failures or operator errors, which can result in significant core damage, confinement system failure, and/or radionuclide releases.

Activation: The process of making a radioisotope by bombarding a stable element with neutrons or protons. (See "neutron activation)

Activity: A measure of the rate at which a material is emitting nuclear radiation, usually given in terms of the number of nuclear disintegrations occurring in a given quantity of material over a unit of time. The standard unit of activity is the Curie (Ci), which is equal to 3.7×10^{10} disintegrations per second.

Acute: Extremely severe or intense for a limited amount of time.

Acute exposure: A single, short-term exposure to radiation, a toxic substance, or other stressors that may result in biological harm. Pertaining to radiation, the exposure incurred during and shortly after a radiological release. Acute exposure involves the absorption or intake of a relatively large amount of radiation or radioactive material.

Acute standard: A numerical limit on the amount of a particular chemical contaminant to which an organism may be exposed over a short period of time.

Afterheat: The heat generated in a reactor core after shutdown by continuing radioactive decay of fission products.

AIRDOS-EPA: A mainframe computer program that calculates atmospheric dispersion and deposition, as well as modeling plume deposition. The terrestrial model for deposition is based on NRC regulations.

Air pollutant: Generally, an airborne substance which could, in high enough concentrations, harm living things or cause damage to materials. From a regulatory perspective, an air pollutant is a substance for which emissions or atmospheric concentrations are regulated or for which maximum guideline levels have been established due to potential harmful effects on human health or welfare.

Air quality: The cleanliness of the air as measured by the levels of pollutants relative to standards or guideline levels established to protect human health and welfare. Air quality is often expressed in terms of the pollutant for which concentrations are the highest percentage of a standard (for example, air quality may be unacceptable if the level of one pollutant is 150% of its standard, even if levels

of other pollutants are will below their respective standards).

Air Quality Control Region (AQCR): An interstate area designated by the Environmental Protection Agency for the attainment and maintenance of National Ambient Air Quality Standards.

Air quality standards: The level of pollutants in the air prescribed by regulations. These levels may not be exceeded during a specified time in a defined area.

ALARA: See "As low as reasonably achievable."

Alloy: A homogeneous mixture of two or more metals.

Alpha activity: The radioactive emission of alpha particles by radioactive materials including uranium and plutonium.

Alpha particle: A positively charged particle ejected spontaneously from the nuclei of some radioactive elements. It is identical to a helium nucleus that has a mass number of 4 and an electrostatic charge of +2. It has low penetrating power and a short range (a few centimeters in air). (See: Alpha radiation.)

Alpha radiation: A strongly ionizing, but weakly penetrating, form of radiation consisting of positively charged alpha particles emitted spontaneously from the nuclei of certain elements during radioactive decay. Alpha radiation is the least penetrating of the four common types of ionizing radiation (alpha, beta, gamma, and neutron). Even the most energetic alpha particle generally fails to penetrate the dead layers of cells covering the skin and can be easily stopped by a sheet of paper. Alpha radiation is most hazardous when an alpha-emitting source resides inside an organism. (See: Alpha particle.)

Alpha wastes: Wastes containing radioactive isotopes which decay by producing alpha particles.

Alternating Gradient Synchrotron (AGS): Completed in 1960, the AGS is used for the study of matter. It is the world's only high energy polarized proton source, and is used for research in both particle and nuclear physics.

Ambient: Surrounding.

Ambient air: The surrounding atmosphere as it exists around people, plants, and structures.

***American Indian Religious Freedom Act* of 1978 (AIRFA):** Establishes national policy to protect and preserve Native Americans' inherent right to the freedom to believe, express, and exercise their traditional religions. This includes the rights of access to religious sites, use and possession of sacred objects, and the freedom to worship through traditional ceremonies and rites.

Anisotropic: Conditions where a physical phenomenon is oriented preferentially in a particular direction or on a particular axis. When the groundwater in a region moves north/south faster than it moves east/west, the groundwater movement is anisotropic.

Appurtenant: Belonging to, accessory to, or attached to a facility, a structure, or a system.

Aquatic (biota): The sum total of living organisms within any designated area of water.

Aquifer: A body of rock or sediment that is capable of transmitting groundwater and yielding usable quantities of water to wells or springs.

***Archaeological and Historic Preservation Act* of 1974 (AHPA):** Preserves historic and archaeological data that could be destroyed or compromised as a result of Federal

construction or other Federally licensed or assisted activities.

Archaeological resources (sites): Any locations where humans have altered the terrain or discarded artifacts during either prehistoric or historic times.

***Archaeological Resources Protection Act* of 1979 (ARPA):** Protects archaeological resources on Federal lands. It requires a permit for archaeological excavations or removal of any archaeological resources located on public or Native American lands. It prohibits interstate or foreign trafficking of archaeological resources taken in violation of state or local laws and requires Federal agencies to develop plans for surveying lands under their control.

Artifact: An object produced or shaped by human workmanship of archaeological or historical interest.

As low as reasonably achievable (ALARA): ALARA means "as low as reasonably achievable", which is the approach to radiation protection to manage and control exposures (both individual and collective) to the work force and to the general public to be as low as reasonable, taking into account social, technical, economic, practical, and public policy considerations. ALARA is not a dose limit but a process that has the objective of attaining doses as far below limits as is practicable.

Assay: Qualitative or quantitative analysis of a substance. An amount of a particular type of material in a sample.

Atmospheric dispersion: The process of air pollutants being dispersed in the atmosphere. This process occurs through wind movement that carries the pollutants away from their source. It is also due to turbulent air motion that results from solar heating of the earth's surface and air movement over rough terrain and surfaces.

Atom: The smallest particle of an element that cannot be divided or broken up by chemical means. It consists of a central core of protons and neutrons, called the nucleus. Electrons revolve in orbits in the region surrounding the nucleus.

***Atomic Energy Act* of 1954:** This act was originally enacted in 1946 and amended in 1954. For the purpose of this Environmental Impact Statement, "...a program for Government control of the possession, use, or production of atomic energy and special nuclear material whether owned by the Government or others, so directed as to make the maximum contribution to the common defense and security and the national welfare and to provide continued assurance of the Government's ability to enter into and enforce agreements with nations or groups of nations for the control of special nuclear materials..." (Section 3(c)).

Atomic Energy Commission: A five-member commission, established by the *Atomic Energy Act*, to supervise nuclear weapons design, development, manufacturing, maintenance, modification, and dismantlement. In 1974, the Atomic Energy Commission was abolished and all functions were transferred to the Nuclear Regulatory Commission and the Administrator of the Energy Research and Development Administration. The Energy Research and Development Administration was later terminated and the functions vested by law in the Administrator were transferred to the Secretary of Energy.

Attainment area: An area designated by the Environmental Protection Agency as being in compliance with one or more of the National Ambient Air Quality Standards (NAAQS) that have been established for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants, but not for

others. (See: National Ambient Air Quality Standards (NAAQS), Nonattainment area, and particulate matter.)

Background radiation: Radiation from (1) cosmic sources, (2) naturally occurring radioactive materials including radon (except as a decay product of source or special nuclear material), and (3) global fallout as it exists in the environment (for example, from the testing of nuclear explosive devices).

Baseline: The existing environmental conditions against which impacts of the proposed action and its alternatives can be compared.

Basin: For geology it is a circular or elliptical downwarp with younger beds in the center after erosion exposes the structure. For topography it is a depression into which the surrounding area drains.

Beam tube: A beam tube is a sealed, hollow tube that runs from the reactor core to the experimental floor of the HFBR. By placing the appropriate plugs and filters inside the beam tube, the desired kind of neutron radiation can be extracted from the reactor core.

Bedrock: The solid rock that underlies loose material, such as soil, sand, and clay.

BEIR V: Biological Effects of Ionizing Radiation; referring to the fifth in a series of committee reports from the National Research Council.

Beta activity: The emission of beta particles by radioisotopes.

Beta particle: A charged particle emitted from a nucleus during radioactive decay, with a mass equal to 1/1837 that of a proton. A negatively charged beta particle is identical to an electron. A positively charged beta particle is called a positron. Large amounts of beta radiation may cause skin burns, and beta emitters are harmful if they enter the body. Beta particles may be stopped by thin sheets of metal or plastic. It is more penetrating than an alpha particle and typically less penetrating than gamma radiation. (See: Beta radiation.)

Beta radiation: Ionizing radiation consisting of fast moving, positively or negatively charged elementary particles emitting from atomic nuclei during radioactive decay. Beta radiation is more penetrating, but less ionizing than alpha radiation. Negatively charged beta particles re identical to electrons; positively charged beta particles are known as positrons. Both are stopped by clothing or a thin sheet of metal. (See: Beta particle.)

Beyond design-basis accident: An accident, generally with more severe impacts to onsite personnel and the public than a design-basis accident (see also: design basis, design-basis accident), initiated by operational or external causes with an estimated probability of occurrence less than 10^{-6} per year and used for estimating the impacts of a facility and/or process.

Biological half-life: The time required for a biological system, such as that of a human, to eliminate, by natural processes, half of the amount of a substance (such as a radioactive material) that has entered it.

Biological Shield: A mass of absorbing material placed around a reactor or radioactive source to reduce the radiation to a level safe for humans.

Bound: To use simplifying assumptions and analytical methods in an analysis of impacts or risks such that the result overestimates or describes an upper limit on (that is, "bounds") potential impacts or risks.

Bounding case: A case that would represent the extreme (high or low) boundaries of a possible situation.

Brookhaven Graphite Research Reactor (BGRR): The world's first nuclear reactor built entirely for peacetime research purposes, the BGRR has been out of service since 1968.

Brookhaven Linac Isotope Producer (BLIP): Used to produce radionuclides that are incorporated into radiopharmaceuticals for use by the pharmaceutical and medical communities and for use in research. BLIP uses the excess beam capability of the linear accelerator that injects protons into the AGS.

Burn: To consume in a reactor through fission.

By-product material: Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or using special nuclear material, and the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.

Cancer: The name given to a group of diseases characterized by uncontrolled cellular growth with cells having invasive characteristics such that the disease can transfer from one organ to another.

Capable fault: In general, "capable fault" means a geologic fault along which it is mechanically feasible for a sudden slip (that is, earth motion) to occur.

Nuclear Regulatory Commission reactor siting regulations define a capable fault as a fault which has exhibited one or more of the following characteristics:
(1) Movement at or near the ground surface at least once within the past 35,000 years or movement of a recurring nature within the past 500,000 years.
(2) macro-seismicity instrumentally determined with records of sufficient precision to demonstrate a direct relationship wit the fault.
(3) A structural relationship to a capable fault according to characteristics (1) or (2) such that movement on one could reasonably expected to be accompanied by movement on the other.

Carbon adsorption: A physiochemical process in which organic and certain inorganic compounds in a liquid stream are absorbed on a bed of activated carbon; used in water or waste purification and chemical processing.

Carbon dioxide (CO_2): A colorless, odorless, nonpoisonous gas that is a normal component of the ambient air; it is an respiration product of normal animal life.

Carbon monoxide (CO): A colorless, odorless gas that is toxic if breathed in high concentration over a period of time.

Cask: A heavily shielded container used to store or ship radioactive materials.

Cermet: A mixture of uranium oxide powder and aluminum powder.

Cesium (Cs): A silver-white alkali metal. A radioactive isotope of cesium, Cs^{137} is a common fission product.

Chain reaction: A reaction that initiates its own repetition. In a fission chain reaction, a fissionable nucleus absorbs a neutron and fissions spontaneously, releasing additional neutrons. These, in turn, can be absorbed by other fissionable nuclei, releasing still more neutrons. A fission chain reaction is self-sustaining when the number of neutrons released in a given time equals or exceeds the number of neutrons lost by absorption in nonfissionable material or by escape from the system.

Chronic: Lasting for a long period of time or marked by frequent recurrence.

Chronic exposure: A continuous or intermittent exposure of an organism to a stressor (for example, a toxic substance or ionizing radiation) over an extended period of time or significant fraction (often 10% or more) of the life span of the organism. Generally, chronic exposure is considered to produce only effects that can be observed some time following initial exposure. These may include impaired reproduction or growth, genetic effects, and other effects such as cancer, precancerous lesions, benign tumors, cataracts, skin changes, and congenital defects.

Chronic standard: A numerical limit on the amount of a particular chemical contaminant that an organism may be exposed to over an extended period of time. The allowable exposure concentration for the chronic standard is less than that of the acute standard.

Cladding: The outer metal jacket of a nuclear fuel elements or target. It prevents fuel corrosion and retains fission products during reactor operation and subsequent storage, as well as providing structural support. Zirconium alloys, stainless steel, and aluminum are common cladding materials.

***Clean Air Act* (CAA):** This Act mandates and enforces air pollutant emissions standards for stationary sources and motor vehicles.

***Clean Air Act Amendments* of 1990 (CAAA):** Expands the Environmental Protection Agency's enforcement powers and adds restrictions on air toxics, ozone depleting chemicals, and stationary and mobile emissions implicated in acid rain and global warming.

***Clean Water Act* of 1972, 1987 (CWA):** This Act regulates the discharge of pollutants from a point source into navigable waters of the United States in compliance with a National Pollutant Discharge Elimination System permit as well as regulates discharges to or dredging of wetlands.

Code of Federal Regulations (CFR): All Federal regulations in force are published in codified form in this document.

Collective Dose: The sum the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation. Collective dose is expressed in units of person-rem or person-Sievert.

Committed Dose Equivalent (CDE): The dose equivalent to organs or tissues that will be received from an intake of radioactive material by an individual during the 50 year period following intake of radioactive material. It does not include contributions from radiation sources external to the body. Committed dose equivalent is expressed in units of rems or Sieverts.

Committed Effective Dose Equivalent (CEDE): The dose value obtained by (1) multiplying the committed dose equivalents for the organs or tissues that are irradiated and the weighting factors applicable to those organs or tissues and (2) summing all the resulting products. Committed effective dose equivalent is expressed in units of rem or Sievert. (See: Committed dose equivalent and Weighting factor.)

Community (biotic): An aggregation of plants and animals having mutual relationships among themselves and to their environment.

***Comprehensive Environmental Response, Compensation, and Liability Act* of 1980 (CERCLA):** A Federal law (also known as Superfund), enacted in 1980 and reauthorized in 1986, that provides the legal authority for emergency response and cleanup of hazardous

substances released into the environment and for the cleanup of inactive waste sites.

Conceptual design: Efforts to develop a project scope that will satisfy program needs, ensure project feasibility and attainable performance levels for congressional consideration, develop project criteria and design parameters for all engineering disciplines, and identify applicable codes and standards, quality assurance requirements, environmental studies, construction materials, space allowances, energy conservation features, health, safety, safeguards, security requirements, and any other features or requirements necessary to describe the project.

Confined aquifer: A permeable geological unit with an upper boundary that is at a pressure higher than atmospheric pressure.

Contamination (contaminated material): The undesirable physical deposition, solvation, or infiltration of radioactive material on or into an object, material, or area, which is then considered to be "contaminated".

Control rods: The elements of a nuclear reactor that absorb slow neutrons and are used to increase, decrease, or maintain the neutron density in the reactor.

Control room: The area in a nuclear power plant from which most of the plant power production and emergency safety equipment can be operated by remote control.

Conversion: The changing of a material from one form, use, or purpose to another.

Coolant: A substance, either gas or liquid, circulated through a nuclear reactor or processing plant to remove heat.

Core: See: Reactor core.

Cosmic radiation: Penetrating ionizing radiation, both particulate and electromagnetic, originating in outer space. Secondary cosmic radiation, formed by interactions in the earth's atmosphere, account for about 45 to 50 millirem of the 360 millirem background radiation that an average individual receives in a year.

Cosmotron Synchrotron: A proton synchrotron that was the first particle accelerator to surpass 1 billion electron volts (GeV). It was dedicated in 1952.

Council on Environmental Quality (CEQ): Established by Congress in 1969 as part of NEPA. In addition to other responsibilities, CEQ oversees Federal agency implementation of the environmental impact assessment process.

Cretaceous Age: The geologic period making up the end of the Mesozoic Era, dating from approximately 144 million to 66 million years ago.

Criteria pollutants: An air pollutant that is regulated by National Ambient Air Quality Standards (NAAQS). The Environmental Protection Agency must describe the characteristics and potential health and welfare effects that form the basis for setting, or revising, the current standard for each regulated pollutant. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter, less than 10 micrometers (0.0004 inch) in diameter, and less than 2.5 micrometers (0.0001 inch) in diameter. new pollutants may be added to, or removed from, the list of criteria pollutants as more information becomes available. (See: National Ambient Air Quality Standards.)

Critical habitat: Habitat essential to the conservation of an endangered or threatened species that has been designated as critical by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the

procedures outlined in the Endangered Species Act and its implementing regulations (50 CFR 424). (See: Endangered species and Threatened species.) The list of Critical Habitats can be found in 50 CFR 17.95 (fish and wildlife), 50 CFR 17.96 (plants), and 50 CFR 226 (marine species).

Critical mass: The smallest mass of fissionable material that will support a self-sustaining nuclear chain reaction.

Critical organ: The body organ receiving a radionuclide or radiation dose that would result in the greatest overall damage to the body. Specifically, that organ in which the dose equivalent would be most significant due to a combination of the organ's radiological sensitivity and the dose distribution throughout the body.

Criticality: The condition in which a system is capable of sustaining a nuclear chain reaction. (See: Chain reaction and Critical mass.)

Crystalline rock: Rock consisting of minerals in a crystalline state.

Cultural resources: Archaeological sites, architectural features, traditional use areas, and Native American sacred sites.

Cumulative dose: The total dose resulting from repeated exposures of ionizing radiation to an occupationally exposed worker to the same portion of the body, or to the whole body, over a period of time (see 10 CFR 20.1003).

Cumulative impacts: Impacts on the environment that result from when the incremental impact of a proposed actin is added to the impacts from other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes the other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Curie (Ci): A unit of radioactivity equal to 37 billion disintegrations per second (or 37 billion becquerels); also a quantity of any radionuclide or mixture of radionuclides having one Curie of radioactivity. It is named for Marie and Pierre Curie, who discovered radium in 1898.

Cut ends: End pieces of reactor fuel elements which are removed (cut) from each fuel element prior to shipment for disposition. The cut ends, which are approximately 30 cm (12 in) long, are radioactive but do not contain spent nuclear fuel and are handled as solid low-level waste.

Deactivated: The condition of a facility or disposal site where steps have been taken to preclude further operation or the further addition of waste materials.

Decay, radioactive: The decrease in the amount of any radioactive material with the passage of time, due to the spontaneous nuclear disintegration (that is, emission from atomic nuclei of charged particles, photons, or both).

Decay heat: The heat produced by the decay of radioactive fission products after a reactor has been shut down.

Decibel (dB): A unit for expressing the relative intensity of sounds on a logarithmic scale from zero for the average least perceptible sound to about 130 for the average level at which sound causes pain to humans. For traffic and industrial noise measurements, the A-weighted decibel (dBA) is widely used.

Decibel, A-weighted (dBA): A unit of weighted sound pressure level, measured by the use of a metering characteristic and the "A" weighting specified by the ANSI S1.4-

1971(R176), that refers to the effect on humans. The A-weighted decibel scale corresponds approximately to the frequency response of the human ear and thus correlates well with loudness.

Decommission: The process of closing down a facility followed by reducing residual radioactivity to a level that permits the release of the property for unrestricted use (see 10 CFR 20.1003).

Decontamination: The reduction or removal of contaminating radioactive material from a structure, area, object, or person. Decontamination may be accomplished by: (1) treating the surface to remove or decrease the contamination, (2) letting the material stand so that the radioactivity is decreased as a result of natural radioactive decay, or (3) covering the contamination to shield or attenuate the radiation emitted (see 10 CFR 20.1003 and §20.1402).

Deep dose equivalent: The deep dose equivalent applies to external whole body exposure and is the dose equivalent at a tissue depth of 1 cm (1,000 mg/cm^2).

Demography: The statistical study of human populations, including size, density, distribution, and such vital statistics as age, sex, and ethnicity.

Department of Energy (DOE): Established in October 1977, DOE's mission is to foster a secure and reliable energy system that is environmentally and economically sustainable, to be a responsible steward of the Nation's nuclear weapons, to clean up its facilities, and to support continued United States leadership in science and technology.

Depleted uranium: Uranium whose content of the fissile isotope U^{235} is less than the 0.7 percent (by weight) found in natural uranium, so that it contains more U^{238} than natural uranium. (See: Natural uranium.) Depleted uranium is derived from spent nuclear fuel and the residues from uranium isotope separation.

Deposition: In geology, the laying down of potential rock-forming materials; sedimentation. In atmospheric transport, the settling out on ground and building surfaces of atmospheric aerosols and particles or their removal from the air to the ground by precipitation.

Design basis: For nuclear facilities, information that identifies the specific functions to be performed by a structure, system, or component and the specific values (or ranges of values) chosen for controlling parameters for reference bounds for design. These values may be: (1) restraints derived from generally accepted state-of-the-art practices for achieving functional goals; (2) requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which a structure, system, or component must meet its functional goals; or (3) requirements derived from Federal safety objectives, principles, goals, or requirements.

Design-basis accident: An accident postulated for the purpose of establishing functional and performance requirements for safety structures, systems, and components.

Design-basis event: A postulated disturbance in a process variable that has the potential to lead to a design-basis accident.

Design-basis phenomena: Earthquakes, tornadoes, hurricanes, floods, etc., that a nuclear facility must be designed and built to withstand without loss of systems, structures, and components necessary to assure public health and safety.

Deuterium (D): A nonradioactive isotope of hydrogen with one proton and one neutron in the nucleus.

Deuterium Oxide: See "Heavy Water."

Direct economic effects: The initial increases in output from different sectors of the economy resulting from some new activity within a predefined geographic region.

Direct jobs: The number of workers required at a site to implement an action.

Direct standardization: See "Standardization"

Discard: To dispose of material as waste.

Discharge: To release by any means or to relinquish control in a manner that could result in a release to the surface waters, groundwaters, surface of the ground, or below ground. (See Suffolk County Sanitary Code, Article 7.)

Dismantlement: The process of taking apart a nuclear facility and removing the subassemblies, components, and individual parts.

Disposal: The process of placing waste in a final repository.

Disposal System: Any plumbing or conveyances which result in or are capable of resulting in a discharge of sewage, industrial wastes, toxic or hazardous materials, stormwater runoff, cooling water or other wastes. This includes but is not limited to septic tanks, leaching pools, sumps, tile fields, holding tanks, outfalls and connecting pipe. (See Suffolk County Sanitary Code, Article 7.)

Dose: A generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent or total effective dose equivalent, as given in the other definitions in this glossary.

Dose, chemical: The amount of a substance administered to, taken up by, or assimilated by an organism. It is often expressed in terms of the amount of substance per unit mass of the organism, tissue, or organ of concern.

Dose commitment: The total dose equivalent a body, organ, or tissue would receive during a specified period of time (for example, 50 years) as a result of intake (as by ingestion or inhalation) of one or more radionuclides from a defined release.

Dose equivalent: A measure of radiological dose that correlates with biological effect on a common scale for all types of ionizing radiation. Defined as a quantity equal to the absorbed dose in tissue multiplied by a quality factor (the biological effectiveness of a given type of radiation) and all other necessary modifying factors at the location of interest. The units of dose equivalent are in the rem and Sievert (Sv).

Dose, radiological: A generic term meaning absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, or committed effective dose equivalent, as defined elsewhere in this glossary.

Dose rate: The ionizing radiation dose delivered per unit time. For example, rem per hour or Sieverts per hour.

Dosimeter: A small device or instrument carried by a worker that measures the cumulative radiation dose received by the worker. Examples of dosimeters are film badges and ionization chambers.

Double-walled: Means constructed with more than one containment layer with space between the layers sufficient to allow monitoring of any leakage into or out of the space. (See Suffolk County Sanitary Code, Article 12.)

Drainage basin: An above-ground area that supplies the water to a particular stream.

Drinking-water standards: The prescribed level of constituents or characteristics in a drinking water supply that cannot be exceeded legally.

Ecology: A branch of science dealing with the interrelationships of living organisms with one another and with their nonliving environment.

Ecosystem: A community of organisms and their physical environment interacting as an ecological unit.

Effective dose equivalent: The dose value obtained by multiplying the dose equivalents received by specified tissues or organs of the body by the appropriate weighting factors applicable to the tissues or organs irradiated, and then summing all of the resulting products. It includes the dose from radiation sources internal or external to the body. The effective dose equivalent is expressed in units of rems or Sieverts. (See: Committed dose equivalent and Committed effective dose equivalent.)

Effective half-life: The time required for the amount of a radioactive element deposited in a living organism to be diminished 50 percent as a result of the combined action of radioactive decay and biological elimination.

Effluent: A waste stream flowing into the atmosphere, surface water, ground water, or soil. Most frequently the term applies to wastes discharged to surface waters.

Electron: An elementary particle with a negative charge and a mass 1/1837 that of the proton. Electrons surround the positively charged nucleus and determine the chemical properties of the atom.

Electron volt (eV): A unit of energy equal to the kinetic energy acquired by an electron passing through a potential difference of 1 volt. Equal to 1.6×10^{-12} erg.

Emergency condition: For a nuclear facility, occurrences or accidents that might occur infrequently during start-up testing or operation of the facility. Equipment, components, and structures might be deformed by these conditions to the extent that repair is required prior to reuse.

Emission standards: Legally enforceable limits on the quantities and/or kinds of air contaminants that can be emitted into the atmosphere.

Empirical: Something that is based on actual measurement, observation, or experience rather than on theory.

Endangered species: Plants or animals that are in danger of extinction through all or a significant portion of their ranges and that have been listed as endangered by the U.S. Fish and Wildlife Service or the National marine Fisheries Service following the procedures outlined in the Endangered Species Act and its implementing regulations (50 CFR 424). (See: Threatened species.)

The list of endangered species can be found in 50 (CFR 17.11) wildlife, 50 CFR 17.12 (plants), and 50 CFR 222.23(a) (marine organisms).

***Endangered Species Act* of 1973:** This act requires Federal agencies, with the consultation and assistance of the Secretaries of the Interior and Commerce, to ensure that their actions will not likely jeopardize the continued existence of any endangered or threatened species or adversely affect the habitat of such species.

Energy Research and Development Administration (ERDA): A precursor to the Department of Energy. Established 1 January 1975, the agency was incorporated into the Department of Energy on 1 October 1977.

Engineered safety features: For a nuclear facility, features that prevent, limit, or mitigate

the release of radioactive material from its primary containment.

Enriched uranium: Uranium whose content of the fissile isotope U^{235} is greater than the 0.7 percent (by weight) found in natural uranium. (See: Natural uranium.)

Environment, safety, and health (ES&H) program: In the context of the Department of Energy, this program encompasses those Department of Energy requirements, activities, and functions in the conduct of all Department of Energy-controlled operations that are concerned with:

- impacts to the biosphere
- compliance with environmental laws, regulations, and standards controlling air, water, and soil pollution
- limiting risks to the well-being of both operating personnel and the general public to acceptably low levels and
- adequately protecting property against loss or damage

Typical activities and functions related to this type of program include, but are not limited to, environmental protection, occupational safety, fire protection, industrial hygiene, health physics, occupational medicine, process and facilities safety, nuclear safety, emergency preparedness, quality assurance, and radioactive and hazardous waste management.

Environmental Assessment (EA): A concise public document that is prepared by a Federal agency under the National Environmental Policy Act (NEPA) to provide sufficient evidence and analysis to determine whether a proposed agency action would require preparation of an environmental impact statement (EIS) or a finding of no significant impact (FONSI). An EA may also be prepared to aid a Federal agency's compliance with NEPA when no EIS is necessary or to facilitate preparation of an EIS when one is necessary.

An EA must include brief discussions of the need for the proposal, alternatives, environmental impacts of the proposed action and alternatives, and a list of agencies and persons consulted. (See: Environmental impact statement, Finding of no significant impact, and National Environmental Policy Act.)

Environmental audit: A documented assessment of a facility to monitor the progress of necessary corrective actions, to ensure compliance with environmental laws and regulations, and to evaluate field organization practices and procedures.

Environmental documentation: Documents describing information and results from studies and evaluations required by NEPA. This documentation may include an EA, EIS or PEIS.

Environmental Impact Statement (EIS): The detailed written statement that is required by section 102(2)(C) of the National Environmental Policy Act (NEPA) for a proposed major Federal actin significantly affecting the quality of the human environment. A DOE EIS is prepared in accordance with applicable requirements of the Council on Environmental Quality NEPA regulations in 40 CFR Parts 1500-1508, and the Department of Energy NEPA regulations in 10 CFR 1021,

The statement includes, among other information, discussions of the environmental impacts of the proposed action and all reasonable alternatives, adverse environmental effects that can not be avoided should the proposal be implemented, the relationship between short-term uses of the human environment and enhancement of long-term productivity, and any irreversible commitments of resources.

Environmental justice: The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or

income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment implies that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, State, local, and tribal programs and policies.

Environmental Survey: A documented, multi-disciplined assessment (with sampling and analysis) of a facility to determine environmental conditions and to identify environmental problems requiring corrective action.

Epicenter: The point on the earth's surface directly above the focus of an earthquake.

Epidemiology: Study of the occurrence, causes and distribution of disease or other health-related states and events in human populations, often as related to age, sex, occupation, ethnic, and economic status, in order to identify and alleviate health problems and promote better health.

Epithermal neutron: A neutron (with a lower kinetic energy level of a few hundredths electron volts (eV) to an upper energy of about 100 eV) which has been slowed down in the moderation process from a high kinetic energy level of about 100 keV. The energy level of an epithermal neutron is just above that of a thermal neutron (about 0.025 eV).

Equivalent sound (pressure) level: The equivalent steady sound level that, if continuous during a specified time period, would contain the same total energy as the actual time-varying sound.

Erosion: The group of natural processes, including weathering, corrosion, and abrasion, by which material is worn away.

Excess latent cancer fatality: Cancer fatalities in excess of those normally expected in a standard population.

Excess mortality: Deaths (from a potential variety of sources) in excess of those normally expected in a standard population.

Exposure: The condition of being subject to the effects of or acquiring a dose of a potential stressor such as a hazardous chemical agent or ionizing radiation. Also the process by which an organism acquires a dose of a chemical or a physical agent such as mercury or ionizing radiation. Exposure can be quantified as the amount of the agent available at various boundaries of the organism (for example, skin, lungs, gut) and available for absorption.

Exposure limit: The level of exposure to a hazardous chemical (set by law or other standard) at or below which adverse human health effects are not expected to occur:

- Reference dose is the chronic exposure dose **(**for example, mg/kg/day**)** for a given hazardous chemical at or below which adverse, non-carcinogenic human health effects are not expected to occur.

- Reference concentration is the chronic exposure concentration **(**for example, mg/m^3**)** for a given hazardous chemical at or below which adverse non-carcinogenic human health effects are not expected to occur.

Exposure pathway: The course a chemical or physical agent takes from the source to the exposed organism. An exposure pathway describes a mechanism by which chemicals or physical agents at or originating from a release site reach an individual or population. Each

exposure pathway includes a source or release from a source, an exposure route, and an exposure point. If the exposure point differs from the source, a transport/exposure medium such as air or water is also included.

External radiation: Exposure to ionizing radiation when the radiation source is located outside the body.

Fault: A fracture or zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred.

Fauna: Animals, especially those of a specific region, considered as a group.

Finding of No Significant Impact (FONSI): A public document issued by a Federal agency briefly presenting the reasons why an action for which the agency has prepared an environmental assessment has no potential to have a significant effect on the human environment and, thus, will not require preparation of an environmental impact statement. (See: Environmental assessment and Environmental impact statement.)

Fissile: The term "fissile" refers to nuclear materials that are fissionable by slow (thermal) neutrons. Fissile materials include U^{235}, U^{233}, Pu^{239}, and Pu^{241}. Materials such as U^{238} and Th^{232}, which can be converted into fissile materials, are called fertile materials. It should be noted that Th^{232}, U^{238} and all plutonium isotopes are fissionable by fast neutrons but not by thermal (slow) neutrons. They are not called fissile materials but may be called fissionable materials.

Fissile material: Although sometimes used as a synonym for fissionable material, this term has acquired a more restricted meaning, namely, any material fissionable by low-energy (that is, thermal or slow) neutrons. Fissile materials include U^{233}, U^{235}, Pu^{239}, and Pu^{241}. (See: Fissionable material.)

Fission: A nuclear transformation that is typically characterized by the splitting of a heavy nucleus into at least two other nuclei, the emission of one or more neutrons, and the release of a relatively large amount of energy. Fission of heavy nuclei can occur spontaneously or be induced by neutron bombardment.

Fission products: Nuclei (fission fragments) formed by the fission of heavy elements, plus the nuclides formed by the fission fragments; radioactive decay.

Fissionable material: Commonly used as a synonym for fissile material, the meaning of this term has been extended to include material that can be fissioned by fast neutrons, such as U^{238}.

Flora: Plants, especially those of a specific region, considered as a group.

Flux: A term applied to the amount of some type of particle (neutrons, alpha radiation, etc.) or energy (photons, heat, etc.) crossing a unit area per unit time. The unit of flux is the number of particles, energy, etc., per square centimeter per second. The HFBR was designed to provide a peak thermal flux of 1.05 x 10^{15} neutrons per cubic meter per second (n/cm3/s) at the 60 MW power level.

Formation: In geology, the primary unit of formal stratigraphic mapping or description.

Fossil: Impression or trace of an animal or plant of past geological ages that has been preserved in the earth's crust.

Fuel (nuclear, reactor): Fissionable material placed in a critical arrangement in the core of a nuclear reactor to serve as the source of reactor power.

Fugitive emissions: (1) Emissions that do not pass through a stack, vent, chimney, or similar

opening where they could be captured by a control device. (2) Any air pollutant emitted to the atmosphere other than from a stack. Sources of fugitive emissions include pumps, valves, flanges, seals, area sources such as ponds, lagoons, landfills, piles of stored material, and road construction areas or other areas where earthwork is occurring.

Gamma radiation: High-energy, short wavelength, electromagnetic radiation emitted from the nucleus of an atom during radioactive decay. Gamma radiation frequently accompanies alpha and beta emissions and always accompanies fission. Gamma rays are very penetrating and are best stopped or shielded by dense materials, such as led or depleted uranium. Gamma rays are similar to, but more energetic than, x-rays. (See: Alpha radiation, Beta radiation, and Fission.)

Gamma rays: High-energy, short-wavelength, electromagnetic radiation accompanying fission and emitted from the nucleus of an atom. Gamma rays are very penetrating and can be stopped only by dense materials (such as lead) or a thick layer of shielding materials.

Gardiners Clay: Gardiners Clay contains variable amounts of green clay, silty, sandy, and gravelly green clay, clayey silt, and sand. It dates from the Pleistocene age, and rests unconformably below the Upper Glacial Aquifer. Gardiners Clay is fairly impermeable and, where present, constitutes a confining layer for the underlying Magothy Aquifer.

Gaussian plume: The distribution of material (a plume) in the atmosphere resulting from the release of pollutants from a stack or other source. The distribution of concentrations about the centerline of the plume, which is assumed to decrease as a function of its distance from the source and centerline (Gaussian distribution), depends on the mean wind speed and atmospheric stability.

Genetic effects: Inheritable changes (chiefly mutations) produced by exposure, to ionizing radiation or other chemical or physical agents, of the parts of cells which control biological reproduction and inheritance.

Geology: The science that deals with the study of the earth: the materials, processes, environments, and history of the planet, including the rocks and their formation and structure.

Glaciofluvial: Materials moved by glaciers and subsequently deposited when the glaciers receded.

Gray (Gy): The SI (International System of Units) unit of absorbed dose. One Gray (Gy) is equal to an absorbed dose of one joule/kg (1 Gy = 100 rads.) (The joule is the SI unit of energy, abbreviated as J.) (See: Absorbed dose.)

Groundwater: Water below the ground surface in a zone of saturation.

Half-life, biological: The time required for the body to eliminate one half of the material taken in by natural biological means.

Half-life, effective: The time required for a radionuclide contained in a biological system, such as a human or an animal, to reduce its activity by one-half as a combined result of radioactive decay and biological elimination.

Half-life, radiological: The time in which one half of the atoms of a particular radionuclide disintegrate into another nuclear form. Half-lives for specific radionuclides vary from millionths of a second to billions of years.

Hazard analysis: The assessment of hazardous situations potentially associated with a process or activity. It includes the identification of material, system, process, and plant characteristics that can produce

undesirable consequences. A safety analysis report hazard analysis examines the complete spectrum of potential accidents that could expose members of the public, onsite workers, facility workers, and the environment to hazardous materials. (See: Safety analysis report.)

Hazard index (HI): A summation of the Hazard Quotients for all chemicals now being used at a site and those proposed to be added to yield cumulative levels for a site. A Hazard Index value of 1.0 or less means that there should be no adverse human health effects (non-carcinogenic).

Hazard quotient (HQ): The value used as an assessment of non-cancer associated toxic effects of chemicals, (for example, kidney or liver dysfunction). The hazard quotient is the ration of an estimated exposure to the exposure expected to have no adverse health effects. A value of 1.0 or less indicates that adverse health effects are not expected. It is independent of a cancer risk, which is calculated only for those chemicals identified as carcinogens.

Hazardous material: Any material, as defined by 40 CFR 171.8, which poses a risk to health, safety, and property when transported or handled.

Hazardous waste: A category of waste regulated under the Resource Conservation and Recovery Act (RCRA). To be considered hazardous, a waste must be a solid waste under RCRA and must exhibit at least one of four characteristics described in 40 CFR 261.20 through 40 CFR 261.24 (that is, ignitability, corrosivity, reactivity, or toxicity) or be specifically listed by the Environmental Protection Agency in 40 CFR 261.31 through 40 CFR 261.33.

Source, special nuclear, or by-product materials as defined by the Atomic Energy Act are not hazardous waste because they are not solid waste under RCRA. (See *Resource Conservation and Recovery Act*, Solid waste, and Waste characterization.)

Heat exchanger: A device that transfers heat from one fluid (liquid or gas) to another.

Heavy metals: Metallic or semimetallic elements that are generally highly toxic to plants and animals and that tend to accumulate in food chains are referred to collectively as "heavy metals." Heavy metals include lead, mercury, cadmium, chromium, and arsenic.

Heavy water: A form of water (a molecule with two hydrogen atoms and one oxygen atom) in which the hydrogen atoms consist largely or completely of the deuterium isotope. Heavy water is also known as "deuterium oxide". Heavy water has almost identical chemical properties, but quite different nuclear properties, as light water (common water).

High efficiency particulate air (HEPA) filter: An air filter capable of removing at least 99.97 percent of particles 0.3 micrometers (about 0.00001 inch) in diameter. These filters include a pleated fibrous medium (typically fiberglass) capable of capturing very small particles.

High-level waste (HLW): Defined by statute (the *Nuclear Waste Policy Act*) to mean the highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste that contains fission products nuclides in sufficient concentrations; and other highly radioactive material that the U.S. Nuclear Regulatory Commission (NRC), consistent with existing law, determines by rule requires permanent isolation. The NRC defines high-level radioactive waste (HLW) to mean irradiated (spent) reactor fuel, as well as liquid waste resulting from the operation of the first cycle solvent extraction system, the concentrated wastes from subsequent

extraction cycles in a facility for reprocessing irradiated reactor fuel, and solids into which such liquid wastes have been converted. There is no known HLW anywhere at BNL.

Highly enriched uranium (HEU): Uranium whose content of the fissile isotope U^{235} has been increased through enrichment to 20 percent or more (by weight). (See: Natural uranium.)

Historic resources: Archaeological sites, architectural structures, and objects produced after the advent of written history dating, in the United States, from 1492.

Hot Lab: A lab designed such that researchers can handle highly radioactive materials remotely to avoid coming into direct contact with those materials.

Hydraulic conductivity: The constant of proportionality in fluid flow that describes the ease with which a porous medium permits fluids to flow and the ease with which the fluid flows given its physical properties.

Hydrogeology: The science dealing with the physical, hydrological, and water quality of groundwater. When describing a groundwater system, one is discussing the hydrogeology of the groundwater or aquifer system.

Hydrology: The science dealing with the properties, distribution, and circulation of natural water systems.

Igneous rock: Class of rock formed by the solidification of molten or partly molten material.

Impervious: Means a layer of natural and/or manufactured material of sufficient thickness, density and composition as to prevent the discharge into the underlying groundwater or adjacent surface waters of any toxic or hazardous substances for a period of at least as long as the maximum anticipated time during which the toxic or hazardous substances will be in contact with the material, and sufficient to allow complete recovery of the spilled product with a minimum disturbance of the containment material. (See Suffolk County Sanitary Code, Article 12.)

Indirect economic effects: Indirect economic effects result from the need to supply industries experiencing direct economic effects with additional outputs to allow them to increase their production. The additional output from each directly affected industry requires inputs from other industries within a region (that is, purchasers of good or services). This results in a multiplier effect to show the change in total economic activity as firms increase their labor inputs.

Indirect jobs: Within a regional economic area, jobs generated or lost in related industries as a result of a change in direct employment.

Indirect standardization: see "Standardization"

Infrastructure: The basic facilities, services, and installations needed for the functioning of a plant or other site, such as transportation and communication systems.

Intensity (of an earthquake): A measure of the effects (due to ground shaking) of an earthquake at a particular location, based on observed damage to structures built by humans, changes in the earth's surface, and reports of how people felt the earthquake. Earthquake intensity is measured in numerical units on the Modified Mercalli scale. (See: Modified Mercalli Intensity scale and Magnitude (of an earthquake).)

Interbedded: Occurring between beds or lying in a bed parallel to other beds of a different material.

Intermittent stream: A stream or reach of a stream that flows primarily during seasonal wet periods.

Internal radiation: Internal radiation arises from the human body metabolizing natural radioactive material that has entered the body by inhalation or ingestion. Natural radionuclides in the body include isotopes of uranium, thorium, radium, radon, polonium, bismuth, potassium, rubidium, and carbon. The major contributor to the annual dose equivalent for internal radioactivity are the short-lived decay products of radon, which contribute about 200 mrem/yr. The average dose from other internal radionuclides is about 39 mrem/yr.

Involved worker: Worker who would participate in a proposed action. (See: Noninvolved worker.)

Ionizing radiation: Any radiation capable of displacing electrons from atoms or molecules, thereby producing ions. Some examples are alpha, beta, gamma, x-rays, neutrons, and ultraviolet light. High doses of ionizing radiation may produce severe skin or tissue damage.

Irradiated: Exposure to ionizing radiation. The condition of reactor fuel elements and other materials in which atoms bombarded with nuclear particles have undergone nuclear changes.

Isotope: Any of two or more variations of an element in which the nuclei have the same number of protons (that is, the same atomic number) but different numbers of neutrons so that their atomic masses differ. Isotopes of a single element possess almost identical chemical properties, but often different physical properties (for example, C^{12} and C^{13} are stable, C^{14} is radioactive).

Joule: A metric unit of energy, work, or heat that is equivalent to one watt-second, 0.239 calories or one Newton-meter.

Karst terrain: A type of land surface that is found in regions underlain by soluble rocks, such as limestone and dolomite, which is peculiar to and dependent upon underground solution of the bedrock and the diversion of surface waters to underground waters (that is, streams that disappear underground). Karst terrain is characterized by sinkholes, underground streams, and caves.

Lacustrine wetland: Lakes, ponds, and other enclosed open waters at least 8 ha (20 acres) in extent and not dominated by trees, shrubs, and emergent vegetation.

Land resources: Land resources are comprised of all of the terrestrial areas available for economic production, residential or recreational use, Government activities, or natural resource consumption.

Land use: The characterization of land in terms of the use potential for the location of various activities.

Landscape character: The arrangement of a particular landscape as formed by the variety and intensity of the landscape features (land, water, vegetation, and structures) and the four basic elements (form, line, color, and texture). These factors give an area a distinctive quality that distinguishes it from its immediate surroundings.

Latent cancer fatalities (LCF): Deaths from cancer resulting from, and occurring some time after, exposure to ionizing radiation or other carcinogens.

Latent fatalities: Fatalities associated with acute and chronic environmental exposure to chemical or radiation which occur years after an exposure takes place.

Light water: The common form of water (a molecule with two hydrogen atoms and one oxygen atom) in which the hydrogen atom consists largely or completely of the normal hydrogen isotope (one proton).

Light water reactor: There are two types of light water reactors. One is a pressurized water reactor and the other is a boiling water reactor. Both are thermal reactors in which circulating light water is used to cool the reactor core and to moderate (reduce the energy of) the neutrons created in the core by the fission reactions. All commercially operating reactors in the United States and most commercial reactors worldwide are light water reactors.

Linac: LINear ACcelerator

Linear Accelerator: An accelerator that is straight, or linear. A linear accelerator does not recirculate particles; the particles go through once. In contrast, the AGS and RHIC are ring accelerators.

Linear Energy Transfer: A measure of the fraction of energy deposited per unit distance that radiation travels.

Lloyd Aquifer: The Lloyd Aquifer underlies the Raritan Clay unit and rests on bedrock. This is the oldest unconsolidated unit in Suffolk County. The unconsolidated sediments of the Lloyd Aquifer consist mainly of fine to coarse sand and gravel, commonly mixed with a clayey matrix and some lenses and layers of silty clay. The aquifer is poorly to moderately permeable and the water is confined.

Loam: Soil composed of a mixture of sand, clay, silt, and organic matter.

Long-lived radionuclides: Radioactive isotopes with half-lives greater than about 30 years.

Loss of coolant accident (LOCA): Those postulated accidents that result in a loss of reactor coolant at a rate in excess of the capability of the reactor makeup system from breaks in the reactor coolant pressure boundary, up to and including a break equivalent in size to the double-ended rupture of the largest pipe of the reactor coolant system.

Low-enriched uranium (LEU): Uranium with a content of the uranium isotope U^{235} greater than 0.7 percent and less than 20 percent by weight. Most nuclear power reactor fuel contains low-enriched uranium containing 3 to 5 percent U^{235}.

Low-income population: Low-income populations, defined in terms of Bureau of Census annual statistical poverty levels (Current Population Reports, Series P-60 on Income and Poverty), may consist of groups or individuals who live in geographic proximity to one another or who are geographically dispersed or transient (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect.

Low-level waste (LLW): Low-level radioactive waste that is managed under the *Atomic Energy Act* of 1954 includes radioactive waste that is not high-level waste, spent nuclear waste, transuranic waste, or by-product material (as defined in section 11e.(2) of the Act). DOE sometimes uses the term to refer also to waste that contains accelerator-produced or naturally-occurring radioactive materials.

Magnitude (of an earthquake): A quantity characteristic of the total energy released by an earthquake, as contrasted to "intensity," which describes its effects at a particular place. Magnitude is determined by taking the common logarithm (base 10) of the largest ground motion recorded on a seismograph during the

arrival of a seismic wave type and applying a standard correction factor for distance to the epicenter. Three common types of magnitude are Richter (or local) (M_L), P body wave (m_b), and surface wave (M_s).

Additional magnitude scales, notably the moment magnitude (M_w), have been introduced to increase uniformity in representation of earthquake size. *Moment magnitude* is defined as the rigidity of the rock multiplied by the area of faulting multiplied by the amount of slip.

A one-unit increase in magnitude (for example, from magnitude 6 to magnitude 7) represents a 30-fold increase in the amount of energy released. (See: Intensity (of an earthquake).)

Magothy Aquifer: The Magothy Aquifer is of Upper Cretaceous age consisting of a maximum of 335 m (1,100 ft) of fine to medium sand interbedded with lenses and layers of course sand, and sandy and solid clay. Gravel is common in the basal or lower zone of the unit. Characterizing the Magothy Aquifer are lignite, pyrite, and iron oxide concretions. The surface configuration of the Magothy Aquifer reflects the historic severe erosion that occurred during several episodes of Pleistocene glaciation which shaped Long Island. Most layers within the Magothy are poorly to moderately permeable with some highly permeable layers occurring locally. The Magothy is a principle aquifer for potable water in Suffolk County.

Makeup: Water used to supplement coolant water lost (for example, through evaporation) during normal reactor operations.

Mandatory standards: Standards adopted by the DOE that define the minimum requirements with which the DOE and its contractors must comply. Standards may be classified as mandatory because of applicable Federal or State statutes or implementing requirements, or as a matter of DOE policy.

Marsh: An area of low-lying wetland, dominated by grasslike plants.

Maximum contaminant level: The maximum permissible level of a contaminant in drinking water delivered to any user of a public water system. Maximum contaminant levels are enforceable standards.

Maximally exposed individual (MEI): A hypothetical individual whose location and habits result in the highest total radiological or chemical exposure (and thus, dose) from a particular source for all exposure routes (including, for example, inhalation, ingestion, or direct exposure).

Megawatt (MW): A unit of power equal to 1 million (10^6) Watts. "Megawatt thermal" is commonly used to describe heat, while "megawatt electric" describes electricity.

Metamorphic rocks: Class of rock formed in the solid state in response to pronounced changes in the temperature, pressure or chemical environment.

Meteorology: The science dealing with the atmosphere and its phenomena, especially as relating to weather.

Microcurie (µCi): One millionth (10^{-6}) of a curie.

Millirem (mrem): One thousandth of a rem. (See: Rem.)

Minority population: Minority populations exist where either (a) the minority population of the affected area excess 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the general population or other appropriate unit of geographic analysis (such as a governing

body's jurisdiction, a neighborhood, census tract, or other similar unit). "Minority" refers to individuals who are members of the following population groups: American Indian or Alaskan Native, Asian or Pacific Islander, Black not of Hispanic origin, or Hispanic. "Minority populations" include either a single minority group or the total of all minority persons in the affected area. They may consist of groups of individuals living in geographic proximity to one another or a geographically dispersed/transient set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect.

Mitigation: Mitigation includes:
(1) avoiding an impact altogether by not taking a certain action or parts of an action,
(2) minimizing impacts by limiting the degree or magnitude of an action and its implementation,
(3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment,
(4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action, or
(5) compensating for an impact by replacing or providing substitute resources or environments.

Mixed waste: Waste that contains both hazardous waste, as defined under the *Resource Conservation and Recovery Act*, and source, special nuclear, or by-product material subject to the *Atomic Energy Act.*

Moderator: A material which functions to slow down the high-energy neutrons liberated in the fission reaction, mainly as a result of elastic scattering.

Modified Mercalli Intensity Scale: The Modified Mercalli Intensity Scale is a standard of relative measurement of earthquake intensity, developed to fit construction conditions in most of the United States. It is a 12-step scale, with values from I (not felt except by a very few people) to XII (damage total). A Modified Mercalli Intensity is a numerical value on the Modified Mercalli Scale. (See: Intensity (of an earthquake).)

Monmouth Greensand: The Monmouth Greensand on Long Island is of Upper Cretaceous age and rests unconformably below the Gardiners Clay, having a reported maximum thickness of as much as 61 m (to 200 ft). The hydrogeologic unit is composed of interbedded marine deposits of clay, silt, and sand deposited in a quite transgressional sea environment. The presence of silt and clay in the sand matrix yield a poorly permeable unit which primarily acts as a confining unit for the underlying Magothy aquifer. The Monmouth Greensand is located near the south shore of Suffolk County and is not located beneath the BNL site.

Moraine: An accumulation of boulders, stones, or other debris carried and deposited by a glacier.

Mutation: Inheritable changes in the DNA structure found in genes potentially caused by exposure to various environmental factors such as radiation or certain chemicals.

Nanocurie: One billionth (10^{-9}) of a curie.

National Ambient Air Quality Standards (NAAQS): Standards defining the highest allowable levels of certain pollutants in the ambient air (that is, the outdoor air to which the public has access). Because the Environmental Protection Agency must establish the criteria for setting these standards, the regulated pollutants are called *criteria* pollutants. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter, less than 10 micrometers (0.0004 inch) in diameter, and less than 2.5 micrometers (0.0001 inch) in diameter. Primary standards are established to protect public health;

secondary standards are established to protect public welfare (that is, visibility, crops, animals, buildings). (See: Criteria pollutant.)

National Emissions Standards for Hazardous Air Pollutants (NESHAPS): Emission standards set by the Environmental Protection Agency for air pollutants which are not covered by National Ambient Air Quality Standards (NAAQS) and which may, at sufficiently high levels, cause increased fatalities, irreversible health effects, or incapacitating illness. These standards are given in 40 CFR Parts 61 and 63. NESHAPS are given for many specific categories of sources (for example, equipment leaks, industrial process cooling towers, dry cleaning facilities, and petroleum refineries).

***National Environmental Policy Act* of 1969 (NEPA):** NEPA is the basic national charter for protection of the environment. It establishes policy, sets goals (in Section 101), and provides means for carrying out the policy. Section (102(2) contains "action-forcing" provisions to ensure that Federal actions significantly affecting the quality of the human environment, Section 102(2)(C) of NEPA requires Federal agencies to prepare a detailed statement that includes the environmental impacts of the proposed action and other specified information.

***National Historic Preservation Act* (NHPA) of 1966, as amended:** This Act provides that property resources with significant national historic value be placed on the National Register of Historic Places. It does not require any permits but, pursuant to Federal Code, if a proposed action might impact a historic property, it mandates consultation with the appropriate agencies.

National Pollution Discharge Elimination System (NPDES): A provision of the Clean Water Act which prohibits discharge of pollutants into waters of the United States unless a special permit is issued by the Environmental Protection Agency, a State, or where delegated, a tribal government on an Indian reservation. The NPDES permit lists permissible discharges or the level of cleanup technology required for wastewater.

National Synchrotron Light Source (NSLS):
A national research facility at BNL. The NSLS provides intense focused light spanning the electromagnetic spectrum from the infrared through x rays. The properties of this light as well as the specially designed experimental stations, called beamlines, allow scientists to perform experiments not otherwise possible at their own laboratories.

National Register of Historic Places (NRHP): The official list of the Nation's cultural resources that are worthy of preservation. The list is maintained by the National Park Service under direction of the Secretary of the Interior. Buildings, structures, objects, sites, and districts are included in the National Register for their importance in American history, architecture, archaeology, culture, or engineering. Properties included on the National Register range from large-scale, monumentally proportioned buildings to smaller scale, regionally distinctive buildings. The listed properties are not just of nationwide importance; most are significant primarily at the state or local level. Procedures for listing properties on the National Register are found in 36 CFR 60.

***Native American Graves Protection and Repatriation Act* of 1990 (NAGPRA):** Established to protect Native American graves and associated funerary objects. This law requires Federal agencies and museums to inventory human remains and associated funerary objects and to provide culturally affiliated tribes with the inventory of collections. Requires repatriation, on request, to the culturally affiliated tribes.

Natural circulation: The circulation of the coolant in the reactor coolant system without the use of reactor coolant pumps. The circulation is due to the natural convection resulting from the different densities of relative cold and heated portions of the system.

Natural uranium: Uranium with the naturally occurring distribution of uranium isotopes (approximately 0.7 weight percent U^{235}, and the remainder essentially U^{238}). (See Depleted uranium, Enriched uranium, Highly enriched uranium, and Low-enriched uranium.)

Neutron: An uncharged elementary particle with a mass slightly greater than that of the proton, and found in the nucleus of every atom heavier than hydrogen.

Neutron activation: The induction of radioactivity in material by irradiation with neutrons, radioactive material, a radiation generating machine, or a nuclear reactor.

Neutron chain reaction: A process in which some of the neutrons released in one fission event cause other fissions to occur. There are three types of chain reactions: (1) Nonsustaining chain reaction: An average of less than one fission is produced by the neutrons released by each previous fission (reactor subcriticality). (2) Sustaining chain reaction: An average of exactly one fission is produced by the neutrons released by each previous fission (reactor criticality). (3) Multiplying chain reaction: An average of more than one fission is produced by the neutrons released by previous fission (reactor supercriticality).

Neutron flux: The number of neutrons passing through a unit area per second.

Neutron radiation: The emission of neutrons from atomic nuclei. Neutrons are uncharged subatomic particles of nearly the same mass as protons. Interaction with atomic nuclei in matter results indirectly in ionization and thus an absorbed dose to biological material. Neutron bombardment of heavy nuclei (for example, uranium or plutonium) can result in fission. Highly penetrating, neutrons can be stopped by thick masses of concrete, water, or paraffin.

Neutron, thermal: A neutron that has (by collision with other particles) reached an energy state equal to that of its surroundings, typically on the order of 0.025 eV (electron volts).

Neutron poison: A chemical solution (for example, boron or rare earth solution) injected into a nuclear reactor to absorb neutrons and end criticality.

Nitrogen oxides: Refers to the oxides of nitrogen, primarily nitrogen oxide (NO) and nitrogen dioxide (NO_2). These are produced in the combustion of fossil fuels and can constitute an air pollution problem. When nitrogen dioxide combines with volatile organic compounds, such as ammonia or carbon monoxide, ozone is produced.

Nonattainment area: An area designated by the U.S. Environmental Protection Agency as not meeting (that is, not in attainment of) one or more of the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants, but not for others. (See: Attainment area, national Ambient Air Quality Standards, and Particulate Matter.)

Noninvolved worker: A worker who would be on the site of an action but would not participate in the action. (See: Involved worker.)

Nonpower reactor: Reactors used for research, training, and test purposes, and for the production of radioisotopes for medical and industrial uses. The HFBR is a nonpower reactor.

Non-stochastic effects: The health effects, the severity of which vary with the dose and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a non-stochastic effect.

Normal operation: A predetermined set of facility processes or functions whereby an expected or "standard" output is the result.

Notice of Intent (NOI): A notice printed in the *Federal Register* announcing that a Federal agency is going to prepare an Environmental Impact Statement.

Nuclear facility: A facility that is subject to special requirements intended to control potential nuclear hazards. Defined in DOE directives as any nuclear reactor or any other facility whose operations involve radioactive materials in such form and quantity that a significant nuclear hazard potentially exists to the employees or the general public.

Nuclear material: Composite term applied to (1) special nuclear material (2) source material such as uranium, thorium, or ores containing uranium or thorium and (3) by-product material, which is any radioactive material that is made radioactive by exposure to the radiation that results from the process of producing or using special nuclear material.

Nuclear power plant: A facility that converts nuclear energy into electrical power. Heat produced in a nuclear reactor is used to make steam, which in turn drives a turbine connected to an electric generator.

Nuclear reactor: A device in which a fission chain reaction is maintained and which is used for irradiation of materials or to produce heat for the generation of electricity.

Nuclear Regulatory Commission (NRC): The NRC is an independent agency established by the U.S. Congress under the *Energy Reorganization Act* of 1974 to ensure adequate protection of the public health and safety, the common defense and security, and the environment in the use of nuclear materials in the United States.

Nucleus: The small, central, positively charged region of an atom that carries the atom's nuclei. Except for the nucleus of ordinary (light) hydrogen, which has a single proton, all atomic nuclei contain both protons and neutrons. The number of protons determines the total positive charge, or atomic number. This is the same for all the atomic nuclei of a given chemical element. The total number of neutrons and protons is called the mass number.

Nuclide: A species of atom characterized by the constitution of its nucleus and hence by the number of protons, the number of neutrons, and the energy content.

Occupational dose limit: The radiological exposure limits to occupational workers promulgated by the NRC or the DOE. The occupational dose limit has been established as 5,000 millirem to the whole body, per year.

Occupational Safety and Health Administration (OSHA): Oversees and regulates workplace health and safety, created by the *Occupational Safety and Health Act* of 1970.

Odds ratio: The ratio of the odds of a disease occurring if exposed to the odds of disease if not exposed. Under certain conditions, the odds ratio approximates the relative risk. Odds ratios are estimated from case-control studies.

Onsite population: DOE employees, contractor employees, and visitors who are onsite.

Operable unit (OU): A discrete action that comprises an incremental step toward comprehensively addressing site environmental problems. This discrete portion of a remedial response manages migration or eliminates or mitigates a release, threat of release, or pathway of exposure. The cleanup of a site can be divided into a number of operable units. The HFBR is in BNL's OU III.

Outfall: The discharge point of a drain, sewer, or pipe as it enters a body of water.

Oxidation: The combination of a substance with oxygen. During this reaction, the atoms in the element combined with oxygen lose electrons and the element's valence (the capacity to combine with other elements) is correspondingly increased.

Oxide: A compound in which an element (such as plutonium) is bonded to oxygen.

Ozone: The triatomic form of oxygen, meaning that three atoms of oxygen have bonded together. In the stratosphere, ozone protects the earth from the sun's ultraviolet rays, but in lower levels of the atmosphere ozone is considered an air pollutant.

Packaging: The assembly of components necessary to perform a containment function and ensure compliance with Federal regulations. It may consist of one or more materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or for absorbing mechanical shocks. The vehicle tie-down system and auxiliary equipment may be designated as part of the packaging. (See also: Cask)

Paleontology: The study of extinct plant and animal life that existed in former geologic times, especially through the study of fossils.

Paleozoic Era: The longest era of geological time occurring 230 million to 600 million years ago, characterized by the appearance of marine invertebrates, primitive fishes, amphibians, reptiles, and seed-bearing land plants.

Palustrine wetland: Nontidal wetlands dominated by trees, shrubs, and emergent vegetation.

Particulate matter (PM), PM_{10}, $PM_{2.5}$: Any finely divided solid or liquid material, other than uncombined (or "pure") water. A subscript denotes the upper limit of the diameter of particles included. This, PM_{10} includes only those particles equal to or less than 10 micrometers (0.0004 inch) in diameter, $PM_{2.5}$ includes only those particles equal to or less than 2.5 micrometers (0.0001 inch) in diameter.

Pathway: A route or course through which a human can be exposed to radiation or chemicals (that is, ingestion, inhalation, absorption, etc.).

PCB: PCBs (polychlorinated biphenyls) are any of a family of chlorinated chemicals that are noted as dangerous environmental pollutants that can accumulate in animal tissues with resultant pathogenic or teratogenic (causing birth defects) effects.

Perennial stream or creek: A stream or reach of a stream that flows continually throughout the year and whose upper surface generally stands lower than the water table in the region adjoining the stream.

Permeability: A measure of the ease with which a fluid can pass through a material.

Person-rem: A unit of collective radiation dose applied to populations or groups of

individuals (See: Collective dose); that is, a unit for expressing the dose when summed across all persons in a specified population or group. One person-rem equals 0.01 person-Sieverts (Sv).

pH: A measure of the relative acidity or alkalinity of a solution, expressed on scale from 0 to 14, with the neutral point at 7.0. Acid solutions have pH values lower than 7.0, and basic (alkaline) solutions have pH values higher than 7.0

Because pH is the negative logarithm of the hydrogen ion (H^+) concentration, each unit increase in pH value expresses a change of state of 10 times the preceding state. Thus, pH 5 is 10 times more acidic than pH 6, and pH 9 is 10 times more alkaline than pH 8.

Piezometer: Generally, a small-diameter, nonpumping well used to measure the elevation of the water table or potentiometric surface. The water table is an imaginary surface that represents the static head of groundwater and is defined by the level to which water will rise.

Picocurie: One-trillionth (10^{-12}) of a curie. (See: Curie.)

Pleistocene: The geological time of the earliest epoch of the Quaternary Period, occurring approximately 11,000 to 2 million years ago, characterized by a succession of northern glaciations and the appearance of human beings.

Plume: The elongated pattern of contaminated air or water originating at a point source, such as the HFBR spent fuel pool. A plume eventually diffuses into a larger volume of less contaminated material as it is transported away from the source.

Plutonium: A heavy, radioactive, metallic element with the atomic number 94. It is produced artificially in a reactor by bombarding uranium with neutrons.

Poison, neutron: In reactor physics, a material other than fissionable material, in the vicinity of the reactor core that will absorb neutrons. The addition of poisons, such as control rods or boron, into the reactor is said to be an addition of negative reactivity.

Poison water: Water containing atoms (usually boron) other than fuel that have large capture cross section for thermal neutrons. In capturing thermal neutrons unproductively, these atoms decrease the number available to cause fission.

Pollution prevention: The use of materials, processes, and practices that reduce or eliminate the generation and release of pollutants, contaminants, hazardous substances, and waste into land, water, and air. For the Department of Energy, this includes recycling activities. (See: Waste minimization.)

Polychlorinated biphenyls (PCBs): Any compound or a mixture of compounds of a family of chlorinated organic chemicals that were formerly manufactured for use as coolants and lubricants in transformers, capacitors, and other electrical equipment. The manufacture of PCBs stopped in the United States in 1977 because of evidence that they build up in the environment and cause harmful effects. PCBs in water, for example, build up in fish and marine mammals and can reach levels thousands of times higher than the levels in water. It is not known whether PCBs cause cancer in people, but the Department of Health and Human Services has determined that PCBs may reasonably be anticipated to be carcinogens. The Environmental Protection Agency has classified all PCBs ad Group B2, possible human carcinogens.

Porosity: Percentage of void space within a soil matrix.

Potable (Water): Fit to drink.

Potential fatalities: A conservative estimate of those fatalities that would result from both radiological and nonradiological risks from normal operations and accident conditions for a proposed action.

Precambrian: Dating from before the Cambrian geologic period more than 570 million years ago.

Prehistoric: Predating written history. In North America, before 1492.

Primary system: The system that circulates a coolant (for example, heavy water in the HFBR) through the reactor core to remove the heat of reaction.

Probabilistic risk assessment (PRA): A comprehensive, logical, and structured methodology to identify and quantitatively evaluate significant accident sequences and their consequences.

Process: To extract, separate, or purify a substance by physical or chemical means (for example, to remove radioactive elements).

Product-Tight: Means impervious to the material which is or could be contained therein so as to prevent the detectable seepage of the product through the container. To be product-tight, the container shall be made of a material that is not subject to physical or chemical deterioration by the product being contained. (See Suffolk County Sanitary Code, Article 12)

***Programmatic Environmental Impact Statement* (PEIS):** A document prepared in accordance with the requirements of 102(2)(C) of NEPA which evaluates the environmental impacts of proposed Federal Actions that involve multiple decisions potentially affecting one or more sites.

Project: Any undertaking with a defined starting point and defined objectives by which completion is identified.

Proton: One of three kinds of elementary particles (the others are electrons and neutrons) that form an atom. The proton has a positive electric charge and is located in the nucleus of an atom.

Quality factor: A multiplying factor applied to absorbed dose to express the biological effectiveness of the radiation producing it. The numerical values of quality factor are given as a function of the linear energy transfer in water for the radiation producing the absorbed dose.

Rad: A unit of radiation absorbed dose (for example, in body tissue). One rad is equal to an absorbed dose of 0.01 joule / kilogram (1 rad = 0.01 Gray). (The joule is the SI unit of energy, abbreviated as J.)

Radiation (ionizing): Particles (alpha, beta, neutrons, and other subatomic particles) or photons (such as gamma, x-rays) emitted from the nucleus of unstable atoms as a result of radioactive decay. Such radiation is capable of displacing electrons from atoms or molecules in the target material (such as biological tissues), thereby producing ions.

Radioactive accident risk: As described in the *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes* (NUREG-0170), it is the probability of an accident in which the release of radioactive material is likely to occur, and its consequences. The consequences are expressed in terms of the potential effects of the release of a specified quantity of dispersible radioactive material to the environment or the exposure resulting from a damaged package shielding. The risk calculations incorporate accident rates and package release fraction estimates, both of which are functions of

accident severity. Radiological accident risks are expressed in terms of annual expected latent cancer fatalities and early fatality probabilities.

Radioactive waste: Waste that is managed for its radioactive content.

Radioactivity: The spontaneous discharge of radiation from the atomic nuclei of radionuclides.

Radioisotope or radionuclide: An unstable isotope that undergoes spontaneous transformation, emitting radiation. (See: Isotope.) Some radioisotopes are manufactured (such as Tc^{99m} and Sn^{117}, which are used in medical diagnosis and research) at the HFBR.

Radionuclide: A radioactive, naturally occurring or manufactured element characterized according to its atomic mass and atomic number.

Radon: A gaseous, radioactive element with the atomic number 86 that results from the radioactive decay of radium. Radon occurs naturally in the environment and can collect in unventilated enclosed areas, such as basements.

Raritan confining unit: The Raritan Clay unit (Upper Cretaceous) underlies the Magothy Aquifer and is as much as 61 m (200 ft) thick. The composition of sediments within the Raritan clays consists of clay, silt, and clayey silt, with scattered lenses and layers of sand mixed in. The Raritan unit is a very poor permeable unit and confines the lower Lloyd Aquifer.

Reaction: Any process involving a chemical or nuclear change.

Reactor accident: See "Design-Basis Accident" and "Severe Accident."

Reactor core: In a heavy water reactor: the fuel assemblies, including the fuel and target tubes, control assemblies, blanket assemblies, safety rods, and coolant/moderator. In a light water reactor, the fuel assemblies, including the fuel and target rods, control rods, and coolant/moderator.

Reactor facility: Unless it is modified by words such as containment, vessel, or core, the term "reactor facility" includes the housing, equipment, and associated areas devoted to the operation and maintenance of one or more reactor cores. Any apparatus that is designed or used to sustain nuclear chain reactions in a controlled manner, including research, test, and power reactors, is defined as a reactor. All assemblies designed to perform subcritical experiments that could potentially reach criticality are also to be considered reactors.

Reactor, nuclear: A device in which nuclear fission may be sustained and controlled in a self-supporting nuclear reaction. The varieties are many, but all incorporate certain features, including fissionable material or fuel, a moderating material (unless the reactor is operated on fast neutrons), a reflector to conserve escaping neutrons, provisions of removal of heat, measuring and controlling instruments, and protective devices.

Receiving waters: Rivers, lakes, oceans, or other bodies of water into which wastewaters are discharged.

Recharge: Replenishment of water to an aquifer.

Record of Decision (ROD): A concise public document that records a Federal agency's decision(s) concerning a proposed action for which the agency has prepared an environmental impact statement (EIS). The ROD is prepared in accordance with the requirements of the Council on Environmental Quality NEPA regulations (40 CFR 1505.2). A

ROD identifies the alternatives considered in reaching the decision, the environmentally preferable alternative(s), factors balanced by the agency in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they were not. (See: Environmental impact statement (EIS).)

Region of Influence (ROI): For this EIS, the geographic area around a DOE site. Distance may vary by resource, for example, an economic ROI is generally larger than the ROI for ecological resources.

Relative risk: The ratio of the risk of disease among the exposed population to the risk of disease in the unexposed population. Relative risks are estimated from cohort studies.

Relativistic Heavy Ion Collider (RHIC): Completed in 1999, the Relativistic Heavy Ion Collider will collide subatomic particles called heavy ions at energies of 100 GeV in each beam. These collision energies are expected to be high enough to create a hot, dense plasma of quarks and gluons. This Quark-Gluon Plasma is believed to have existed in the early universe immediately after the beginning of the universe.

Rem: A unit of dose equivalent. The dose equivalent in rems equals the absorbed dose in rads in tissue multiplied by the appropriate quality factor and possibly other modifying factors. Derived from "Roentgen equivalent man," referring to the dosage of ionizing radiation that will cause the same biological effect as one roentgen of x-ray or gamma-ray exposure. One rem equals 0.01 Sievert. (See: Absorbed dose, Dose equivalent, and Quality factor.)

Remediate: Render radioactive, hazardous, or mixed waste environmentally safe, whether through processing, entombment, or other methods.

Remediation: The process, or a phase in the process, of rendering radioactive, hazardous, or mixed waste environmentally safe, whether through processing, entombment, or other methods.

Reprocessing: The chemical separation of spent reactor fuel into uranium, transuranic elements, and fission products.

***Resource Conservation and Recovery Act*, as amended (RCRA):** A law that gives the Environmental Protection Agency the authority to control hazardous waste from "cradle to grave" (that is, from the point of generation to the point of ultimate disposal), including its minimization, generation, transportation, treatment, storage, and disposal. RCRA also sets forth a framework for the management of non-hazardous solid wastes. (See: Hazardous waste and Solid waste.)

Richter scale: A logarithmic scale used to express the total amount of energy released by an earthquake; it has 10 divisions, from 1 (not felt by humans) to 10 (nearly total damage).

Risk: The probability of a detrimental effect from exposure to a hazard. Risk is often expressed quantitatively as the probability of an adverse event occurring multiplied by the consequence of that event (that is, the product of these two factors). However, separate presentation of probability and consequences is often more informative.

Risk assessment (chemical or radiological): The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemical or radiological pollutants.

Roentgen (R): A unit of exposure to ionizing radiation. It is the amount of gamma or x-rays required to produce ions resulting in a charge of

0.000258 coulombs/kilogram of air under standard conditions. Named after Wilhelm Roentgen, the German scientist who discovered x-rays in 1895.

Runoff: The portion of rainfall, melted snow, or irrigation water that flows across the ground surface and eventually enters a stream.

***Safe Drinking Water Act*, as amended:** This Act protects the quality of public water supplies, water supply and distribution systems, and all sources of drinking water.

***Safety Analysis Report* (SAR):** A report which systematically identifies potential hazards within a nuclear facility, describes and analyzes the adequacy of measures to eliminate or control identified hazards, and analyzes potential accidents and their associated risks. Safety analysis reports are used to ensure that a nuclear facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations. Safety analysis reports are required for DOE nuclear facilities and as a part of applications for Nuclear Regulatory Commission licenses. Specific content requirements are found in the NRC regulations or DOE Orders and Technical Standards that apply to the facility type. (See: Nuclear facility.)

Sanitary wastes: Wastes generated by normal housekeeping activities, liquid or solid (including sludge), that are not hazardous or radioactive.

Schist: Crystalline metamorphic rock formed by dynamic metamorphism that can be split easily into thin slabs or flakes.

Scope: In a document prepared pursuant to NEPA, the range of actions, alternatives, and impacts to be considered.

Scoping: An early and open process for determining the scope of issues to be addressed in an environmental impact statement (EIS) and for identifying the significant issues related to a proposed action.

The scoping period begins after publication in the *Federal Register* of a Notice of Intent (NOI) to prepare an EIS. The *public scoping process* is that portion of the process where the public is invited to participate. DOE also conducts an early *internal* scoping process for environmental assessments (EAs) or EISs. For EISs, this internal scoping process precedes the public scoping process. DOE's scoping procedures are found in 10 CFR 1021.311.

Secondary system: The system that circulates a coolant through a heat exchanger to remove heat from the primary system.

Seismic: Pertaining to any earth vibration, especially an earthquake.

Seismic zone: An area defined by the *Uniform Building Code* (1991), designating the amount of damage to be expected as the result of earthquakes. The United States is divided into six zones: 1) Zone 0–no damage; 2) Zone 1–minor damage, corresponds to intensities V and VI of the Modified Mercalli Intensity Scale; 3) Zone 2A–moderate damage, corresponds to intensity VII of the Modified Mercalli Intensity Scale (eastern United States); 4) Zone 2B–slightly more damage than 2A (western United States); 5) Zone 3–major damage, corresponds to intensity VIII or higher of the Modified Mercalli Intensity Scale; 6) Zone 4–areas within Zone 3 determined by proximity to major fault systems.

Seismicity: The measure of vibration caused by an earthquake.

Severe accident: An accident with a frequency rate of less than 10^{-6} per year that would have more severe consequences than a design-basis accident, in terms of damage to the facility, offsite consequences, or both.

Sewage: The total of organic waste and wastewater generated by an industrial establishment or a community.

Shielding: Any material or obstruction that absorbs radiation and thus tends to protect personnel or materials from the effects of ionizing radiation.

Short-lived nuclides: Radioactive isotopes with half-lives no greater than about 30 years (for example, Cs^{137} and Sr^{90}).

Shutdown: For a DOE reactor, that condition in which the reactor is no longer critical and has ceased operation either temporarily or permanently.

Sievert (Sv): The SI (International System of Units) unit of radiation dose equivalent. The dose equivalent in Sieverts equals the absorbed dose in Grays multiplied by the appropriate quality factor (1 SV = 100 rem). (See: Gray.)

Silica: Silicon dioxide, a common mineral that occurs naturally as quartz.

Silt: A sedimentary material consisting of fine mineral particles intermediate in size between sand and clay.

Small Angle Neutron Scattering Facility (SANS): An instrument used primarily for structure determinations of macromolecules of biological interest.

Socioeconomic baseline characterization: A description and discussion of the social and economic characteristics of a study area, including a profile of local population, economy, housing supply, and public and private services.

Solid waste: In general, solid wastes are non-liquid, non-soluble discarded materials ranging from municipal garbage to industrial wastes that contain complex and sometimes hazardous substances. Solid wastes include sewage sludge, agricultural refuse, demolition wastes, and mining residues.

For purposes of regulation under the *Resource Conservation and Recovery Act*, solid waste is any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material. Solid waste includes solid, liquid, semisolid, or contained gaseous material resulting form industrial, commercial, mining, and agricultural operations and from community activities. Solid waste does not include solid or dissolved material in domestic sewage or irrigation return flows or industrial discharges which are point sources subject to permits under Section 402 of the *Clean Water Act.* Finally, solid waste does not include source, special nuclear, or by-product material as defined by the *Atomic Energy Act.* A more detailed regulatory definition of solid waste can be found in 40 CFR 261.2 (See: Hazardous waste and *Resource Conservation and Recovery Act.*)

Somatic effects of radiation: Effects of radiation limited to the exposed individual, as distinguished from genetic effects, which may also affect subsequent unexposed generations.

Source material: In general, material from which special nuclear material can be derived. Under the *Atomic Energy Act* and Nuclear Regulatory Commission regulations, "source material" means uranium and thorium in any physical or chemical form, as well as ores which contain one-twentieth of one percent (0.05%) or more by weight of uranium or thorium. (See: Special nuclear material.)

Source term: The amount of a specific pollutant (for example, a chemical or a radionuclide) emitted or discharged to a particular environmental medium (for example, air or water) from a source or group of sources. It is usually expressed as a rate (that is, an amount per unit time.)

Special nuclear material: A category of material subject to regulation under the *Atomic Energy Act*, consisting primarily of fissile materials. It is defined to mean plutonium, U^{233}, or uranium enriched in the isotopes U^{233} or U^{235} or any other material that the Nuclear Regulatory Commission determines to be special nuclear material, but it does not include source material.

Spent (depleted) fuel: Nuclear reactor fuel that has been used to the extent that it can no longer effectively sustain a chain reaction.

Spent fuel pool: An underwater storage and cooling facility for fuel elements that have been removed from a reactor.

Spent nuclear fuel: Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated.

Staging: An interim storage or gathering of items awaiting use, transportation, consumption, or other disposition.

Standardization (Epidemiology): Techniques used to control the effects of differences (for example, age) between populations when comparing disease experience. There are two main methods:

- Direct method, in which specific disease rates in the study population are averaged, using the distribution of the comparison population as a weight.

- Indirect method, in which the specific disease rates in the comparison population are averaged, using the distribution of the study population as a weight.

Standardized mortality ratio: The standardized mortality ratio (SMR) is the ratio of the number of fatalities observed in the study population to the number of expected fatalities. The expected number of fatalities is based on a reference (or comparison population). Fatality rates for the U.S. (or State) population are most frequently used as the comparison to obtain expected rates. An SMR of 1 indicates a similar risk of disease in the study population compared with the reference population. An SMR greater than 1 indicates excess risk of disease in the study population compared with the reference group, and an SMR less than 1 indicates a deficit of disease.

Standby: That condition in which a reactor facility is neither operable nor declared excess and in which documentary authorization exists to maintain the reactor for possible future operation.

State Historic Preservation Officer (SHPO): State officer established to carry out the duties associated with the *National Historic Preservation Act*, for identification and protection of prehistoric and historic resources.

Stochastic effects: Effects that occur by chance, generally occurring without a threshold level of dose, whose probability is proportional to the dose and whose severity is independent of the dose. In the context of radiation protection, the main stochastic effects are cancer and genetic effects.

Storage: Any method of keeping items while awaiting use, transportation, consumption, or other disposition.

Storage facility: Means tanks, pipes, vaults, buildings, yards, pavements or fixed containers used or designed to be used, either singly or in any combination thereof, for the storage and/or transmission of toxic or hazardous materials or for the storage of portable containers containing toxic or hazardous materials. This shall include skid or wheel-mounted tanks if

they are used for storing toxic or hazardous materials in a manner that could be accomplished by the use of fixed or permanently installed tanks, but shall not include the temporary use of wheeled or skid-mounted tanks for the purpose of dispensing petroleum products into "off-road" vehicles and other equipment used for construction-related purposes at construction sites, or for temporary use at spill cleanup or groundwater remediation sites. (See Suffolk County Sanitary Code, Article 12.)

Stratigraphy: Division of geology dealing with the definition and description of rocks and soils, especially sedimentary rocks.

Sulfur oxides: Common air pollutants, primarily sulfur dioxide (SO_2) considered a major air pollutant, a heavy, bad-smelling, colorless gas usually formed in the combustion of coal and sulfur trioxide (SO_3).

***Superfund Amendments and Reauthorization Act* of 1986 (SARA):** In addition to certain freestanding provisions of law, it includes amendments to CERCLA and the SDWA.

Surface water: All bodies of water on the surface of the earth and open to the atmosphere, such as rivers, lakes, reservoirs, ponds, seas, and estuaries.

Surplus facility: Any facility or site (including installed equipment) that has no identified programmatic use or that may or may not be radioactively contaminated to levels that require controlled access.

Synchrotron: A recirculating accelerator that uses high-frequency RF (radio frequency) cavities to accelerate and bunch particles.

Tandem Van de Graaff Electrostatic Accelerator: The BNL Tandem Van de Graaff Facility consists of two model MP electrostatic accelerators, associated beam transport lines, experimental areas and test facilities. One of the accelerators has been upgraded to run at a maximum terminal voltage of 15.5 MV and is also capable of high intensity pulsed beam operation. The other accelerator is currently undergoing a similar upgrade.

Terrestrial (biotic): The sum total of living organisms within any designated land area.

Terrestrial Radiation: Radiation emitted from the radioactive materials in the earth's rocks and soils. The average annual dose from external terrestrial radiation is about 28 mrem.

Thermal neutron: A neutron which has the kinetic energy of about 0.025 eV. The thermal neutron is in thermal equilibrium with the substance in which it exists and will neither gain nor lose energy statistically until it is captured by a neutron absorber.

Thermalization: The process undergone by high-energy (fast) neutrons as they lose energy by collision.

Threatened species: Any plants or animals that are likely to become endangered species within the foreseeable future throughout all or a significant portion of their ranges and which have been *listed* as threatened by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures set out in the Endangered Species Act and its implementing regulations (50 CFR 424). (See: Endangered species.)

The lists of threatened species can be found at 50 CFR 17.11 (wildlife), 17.12 (plants), and 227.4 (marine organisms).

Threshold limit values: The maximum concentrations of contaminants to which workers may be exposed. Threshold limit values are 8-hour time weighted average concentrations that should not be exceeded.

Total Effective Dose Equivalent (TEDE): The sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures). (See: Effective dose equivalent and Committed effective dose equivalent.)

Till: Unstratified glacial drift deposited directly by the ice and consisting of clay, sand. gravel, and boulders intermingled in any proportion. Till deposits are poor aquifers and yield very little water.

***Toxic Substances Control Act* of 1976 (TSCA):** This Act authorizes the Environmental Protection Agency to secure information on all new and existing chemical substances and to control any of these substances determined to cause an unreasonable risk to public health or the environment. This law requires that the health and environmental effects of all new chemicals be reviewed by the EPA before they are manufactured for commercial purposes.

Transportation and Emergency Management Program: The transportation program is responsible for the safe movement of wastes among facilities for the purposes of treatment, storage, and disposal. The emergency management program is responsible for coordinating the response to adverse occurrences in environmental restoration and waste management operations.

Transuranic: Refers to any element whose atomic number is higher than that of uranium (atomic number 92), including neptunium, plutonium, americium, and curium. All transuranic elements are produced artificially and are radioactive.

Transuranic waste (TRU): Radioactive waste that is not classified as high-level radioactive waste and that contains more than 100 nanocuries (3700 becquerels) per gram of alpha-emitting transuranic isotopes with half-lives greater than 20 years. TRU waste is not generated, treated, or stored at BNL.

Treatment: An operation necessary to prepare material for disposal.

Tributary: Any stream which contributes water to another stream or river.

Tritium: A radioactive isotope of hydrogen (one proton, two neutrons). Because it is chemically identical to natural hydrogen, tritium can easily be taken into the body by any ingestion path. It decays by beta emission. It has a radioactive half-life of about 12.5 years. Common symbols for the tritium isotope are H^3 and T.

Unconfined aquifer: A permeable geological unit that has a water-filled pore space (saturated), the capability to transmit significant quantities of water under ordinary differences in pressure, and an upper water boundary that is at atmospheric pressure.

Upper Glacial Aquifer: The Upper Glacial Aquifer is of Pleistocene Age and is present throughout the majority of Suffolk County. The Pleistocene sediments are deposited in a glaciofluvial environment during the Wisconsin glaciation. It is a shallow aquifer composed of outwash deposits of fine to course sand and pebble to boulder-sized gravel having a total thickness of as much as 213 m (700 ft).

Uranium (U): A radioactive element with the atomic number 92 and, as found in natural ores, an atomic weight of approximately 238. The two principal natural isotopes are U^{235} (0.7 percent of natural uranium), which is fissile, and U^{238} (99.3 percent of natural uranium), which is fissionable by fast neutrons and is fertile. Natural uranium also includes a minute amount of U^{234}.

Visual resources: Natural and cultural features that define the appearance of a particular landscape.

Volatile organic compounds (VOCs): A broad range of organic compounds, often halogenated, that vaporize at ambient or relatively low temperatures (for example, benzene, chloroform, and methyl alcohol).

Waste: A discardable residue from a manufacturing or purification process.

Waste minimization: Actions that economically avoid or decrease waste production by reducing waste generation at the source, reducing the toxicity of hazardous waste, improving efficiency of energy usage, or recycling wastes.

Waste, radioactive: Solid, liquid, and gaseous materials from nuclear operations that are radioactive or become radioactive and for which there is no further use. Wastes are generally classified as high-level (having radioactivity concentrations of hundreds of thousands of curies per gallon or cubic foot), low-level (in the range of 1 microcurie per gallon or cubic foot), or intermediate level (between these extremes)

Wastewater: Spent water originating from all aspects of human sanitary water use (domestic wastewater) and from a myriad of industrial processes that use water for a variety of purposes (industrial wastewater).

Water quality standards and criteria: Concentration limit of constituents or characteristics allowed in water; often based on water use classifications (for example, drinking water, recreation use, propagation of fish and aquatic life, and agriculture and industry use). Water quality standards are legally enforceable; water quality criteria are non-enforceable recommendations based on biotic impacts.

Water table: Water under the surface of the ground occurs in two zones: an upper, unsaturated zone; and the deeper, saturated zone. The boundary between the two zones is the water table.

Weighting factor: Generally, a method of attaching different importance values to different items or characteristics. In the context of radiation protection, the proportion of the risk of effects resulting from irradiation of a particular organ or tissue to the total risk of effects when the whole body is irradiated uniformly (that is, the organ dose weighting factor for the lung is 0.12, compared to 1.0 for the whole body). Weighting factors are used for calculating the effective dose equivalent.

Wetland: Land or areas exhibiting hydric soil conditions, saturated or inundated soil during some portion of the year, and plant species tolerant of such conditions.

Whole-body dose: Dose resulting from the uniform exposure of all organs and tissues in a human body. Also, see "Effective Dose Equivalent."

Whole-body exposure: An exposure of the body to radiation, in which the entire body, rather than an isolated part, is irradiated. Where a radioisotope is uniformly distributed throughout the body tissues, rather than being concentrated in certain parts, the irradiation can be considered as whole-body exposure.

***Wild and Scenic Rivers Act*:** This Act establishes a National Wild and Scenic Rivers System to preserve and protect the free-flowing condition of selected rivers with outstanding natural, cultural, or recreational features. For Federally-owned land within the boundaries of rivers in the System, certain activities that would have a direct and adverse effect on river values may be controlled.

Wind rose: A depiction of wind speed and direction frequency for a given period of time.

Wisconsin Age: Of the fourth glacial stage of the Pleistocene Epoch in North America.

c/Q (Chi/Q): The relative calculated air concentration due to a specific air release; units are $\frac{\text{sec}}{m3}$. For example, $\frac{Ci}{m3} \div \frac{Ci}{\text{sec}} = \frac{\text{sec}}{m3}$ or $\frac{gm}{m3} \div \frac{gm}{\text{sec}} = \frac{\text{sec}}{m3}$.